AIR DRYING AND STICKER STAINING OF 4/4 SUGAR MAPLE FLOORING STOCK IN UPPER MICHIGAN

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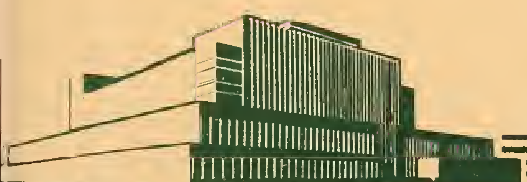

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AIR DRYING AND STICKER STAINING OF 4/4 SUGAR MAPLE FLOORING STOCK IN UPPER MICHIGAN

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Summary

Sugar maple flooring stock 1 inch thick that contained about 27 percent of heartwood was air dried in packages in Upper Michigan to a moisture content of 20 percent in 40 to 205 days. The mean air-drying period was about 90 days.

The average loss caused by all drying defects, including sticker stain, was $9.42 per 1,000 board-feet,[2] or 11.3 percent of the green value. Checking, splitting, and warping losses accounted for $4.86 of the total, and the remaining $4.56 is chargeable to sticker staining.

Losses from all causes for lumber dried in an open shed averaged $3.77 less per 1,000 board-feet than for lumber dried in roofed yard piles, and $5.58 less than for lumber dried in roofless piles.

Wide, green stickers that were used in one-half of the packages caused much greater sticker-stain losses than did narrow, dry stickers ($5.72 more per 1,000 board-feet). However, wide, green stickers caused no appreciable

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[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2] The lumber prices used were: First and Second, $200; Select, $171; No. 1 Common, $120; No. 2 Common, $70; No. 3A Common, $50; and No. 3B Common, $37 per 1,000 board-feet.

increase in checking, splitting, and warping losses (only $0.12 more per 1,000 board-feet).[3]

Lumber piled with narrow, dry stickers in both roofed and roofless yard piles declined considerably more in value than did lumber piled with narrow, dry stickers in the shed; losses were $5.35 greater for the roofed piles and $7.05 greater for the roofless piles. The cost of an open, pole-type shed can be amortized in 4 to 5 years on the basis of the indicated savings.

Introduction

Most hardwood lumber is air dried, and it may later be kiln dried at the sawmill or at the plant of the consumer. In air drying, the loss in value caused by drying defects must be added to the cost. Drying defects are of two kinds: those caused by shrinkage, such as warping, checking, and splitting, and those caused by staining, such as blue or sap stain and chemical stain. Warping is caused not only by shrinkage but by loads imposed on the boards because of poorly constructed piles. Drying defects cannot be eliminated, but usually they can be reduced appreciably. For example, dipping the green lumber in solutions of antistain chemicals largely prevents sap stain but not chemical stain. Improved piling techniques reduce defects that result from poor piling practices. Where drying defects are reduced, the cost of the air drying is cut and its efficiency increased.

Sugar maple flooring stock 1 inch thick was air dried in Upper Michigan to determine the periods of time required to dry the lumber to a moisture content of 20 percent and to establish the effect of such factors as sheds, pile roofs, and type of sticker on drying losses. The lumber was of random widths and lengths, obtained from the green chain of the mill. The grade was principally No. 2 Common, with some No. 1 and No. 3A and an occasional board of higher grade.

Units Used for Test

Each test unit consisted of six packages of lumber about 4 feet wide, 14 feet long, and 24 courses high. A few 16-foot boards were included and were allowed to project 2 feet at one end. The boards were piled roughly edge to

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[3] The average value of the green lumber was $83.57 per 1,000 board-feet.

edge on 5 tiers of stickers spaced 3-1/2 feet. Stickers used were of dry, rough 1- by 2-inch hemlock and 1- by 3- to 6-inch sugar maple cut from fresh green lumber. In each unit, three packages were made with narrow, dry stickers and three with wide, green stickers. The test packages were placed on top of two other packages to make up the piles that were placed in the yard or in the shed (fig. 1).

The drying yard was located on a high, dry site fully exposed to the wind. The shed was open on both sides, and had a capacity of eight piles in each of six bays. It could be entered from both sides by a forklift truck. The piles were placed on 6- by 6-inch crossbeams that were laid across the permanent beams of the pile foundations and a central support. The bottom of the first course of lumber in the piles was about 16 inches from the ground. The test piles in the yard were placed in an inner row with a shield pile at each end of a row of four test piles. Both types of stickers were represented in the two test packages in the shed and the four in the yard. Of the four test packages in the yard, one with each type of sticker was roofed.

Each board of a test package was numbered, starting with the left-hand board facing the front or flush end of the test package and ending with the right-hand board of the top course. Two boards placed end to end bore the same number, the front one bearing a subscript a and the rear one a subscript b.

Each test package contained 9 whole-board samples. Three were placed in the second, twelfth, and twenty-third lumber courses. In each of these courses, 1 whole-board sample was placed in the center, and 1 was placed on each edge. Each whole-board sample was weighed when fresh and green and examined critically for splits, shake, and checks. The whole-board samples were numbered independently.

For pile samples, 4-foot lengths were cut from green lumber. These were end coated and when the piles were erected they were placed in the bolster space immediately below the test package.

Each pile roof consisted of one 4- by 8-foot panel and one 4- by 10-foot panel. They were constructed by nailing shiplap to a framework of 2 by 4's (fig. 1).

Test Procedure

Six piles containing the test packages at the tops were erected during January, May, July, and October of 1955. The piles remained in the yard or in the shed until the moisture content of the lumber was approximately 20 percent.

When the weights of pile samples indicated that the required moisture content had been reached, the piles were dismantled. After air drying, the lumber was dried in a kiln to a moisture content of 5 to 6 percent. It was then dressed on both sides to a thickness of 7/8 inch.

Tests and Measurements

All the boards of the test packages, including the whole-board samples, were graded when green. They were also graded in the rough air-dry condition, and those containing sticker stain were graded after kiln drying and dressing.

All moisture-content values were determined for both pile samples and whole-board samples by a combination of weighing and testing by the oven method.

Checks and splits were measured or estimated in terms of total inches of length. These measurements were made on the pile and whole-board samples only. End splits (surface checks that extend to an end, or end checks that extend to the edge and along on the face of the board) were not measured in total inches but in inches corresponding to the length of the longest split present at either end.

Sticker stains were classified on a qualitative basis. A barely perceptible stain was classified as No. 1, a stain that was readily perceptible as No. 2, and one that was conspicuous as No. 3. Boards that contained sticker stain were inspected to determine the effect of the sticker-stain marks on grade.

The Data

Climatological

Since the drying of lumber piled in a yard or an open shed is directly affected by the surrounding air, the characteristics of this air, or the climatological data for the region, play an important role. The mill where the work was conducted is in a cold region. The temperature averages below freezing for 4-1/2 months of the year and above 60° F. for only about 2-1/2 months. Total annual precipitation is about 30 inches. Figure 3 shows the approximate climatological conditions for a year based on data from Weather Bureau records taken at neighboring points. Using mean monthly temperatures and relative humidities as bases, the year was divided into two periods of 6 months. From the middle of April to the middle of October, the climatological conditions are favorable to rapid drying, so this period was designated as the active-drying

period. The remainder of the year was designated as the slow-drying period. From the middle of November until the first of April, drying is particularly slow because the temperature averages below freezing. The equilibrium moisture content data for wood were derived from mean monthly temperatures and relative humidities and charts that give their relation to wood moisture content (fig. 2). From April through August, the value for equilibrium moisture content is about 14 percent. During March, September, and October it averages about 15.5 percent, and during November, December, January, and February it averages 16 to 17 percent.

Drying

The piles that contained the May and July test packages were erected during the active-drying period. The piles that contained the October test packages remained in the shed and in the yard throughout the entire slow-drying period. January piles were erected near the midpoint of the slow-drying period.

Figure 3 shows drying curves for the lumber of the four sets of test packages, based on data collected on the pile samples and on the whole-board samples. The drying curves for the May and July lumber exhibit the properties of theoretical drying curves. The curves for lumber dried in January and October possess no positive characteristics because of the extremely slow drying during the winter. The moisture content of the lumber piled in October did not actually reach 20 percent, but it did reach 24 percent after 165 days of drying. There was a spell of damp and rainy weather about 10 days before the October piles were dismantled. The dotted portion of the curve was drawn to indicate that the lumber piled in October should have dried to a 20 percent moisture content in about 170 days. According to the drying curves, the moisture content of lumber piled in January reached 20 percent in 94 days, that piled in May in 39 days, that piled in July in 42 days, and that piled in October in 170 days.

The drying periods for the four sets of test packages, are indicated by the solid bars in figure 4. The hollow bars were drawn by interpolation and indicate the approximate drying periods required for lumber piled at the midpoint of each month of the year. These data indicate that 4/4 sugar maple piled in Upper Michigan during May, June, and July can be air dried to a moisture content of approximately 20 percent in about 40 days. Lumber piled during September must remain in the yard until the following April. It will therefore dry in about 205 days. Forty days may be considered the minimum and 205 days the maximum. Lumber piled during November, December, and January also dried to 20 percent moisture content during the following April; therefore the drying periods become progressively shorter. If the drying periods indicated

for lumber piled during each month are averaged, the mean air-drying period is about 90 days. If an equal amount of lumber were piled in the yard during each month of the year, there would be an accumulation of lumber during April. This quantity would represent 5 to 6 months' production.

Figure 4 shows not only air-drying periods but also mean monthly temperatures and equilibrium moisture content values for wood, which are derived from these mean monthly temperatures and the mean monthly relative humidities. These values indicate that it should be possible to reduce lumber to a 20 percent moisture content during any month of the year. The moisture content of lumber piled early in October might reach 20 percent during January, February, or March, but unless the moisture content had nearly reached 20 percent about the middle of November, the free water would freeze and prevent the lumber from drying to this moisture content during the winter months.

Surface Checking

Table 1 presents the amount of surface checking that occurred in the nine whole-board samples of the test packages that started air drying during January, May, July, and October. A statistical analysis indicates significant differences between amounts of surface checking in all of the main categories. Lumber piled in October checked the least and lumber piled in January the most. Lumber piled in the yard without a roof checked the most, and the lumber piled within the shed checked the least. Surface checking was more severe in test packages built with wide, green stickers than it was in those built with narrow, dry stickers. Boards located near the tops of the test packages checked more than those lower down.

Water that froze in the green lumber piled in January may have contributed to the severe surface checking. Water diffuses slowly in wood at low temperatures, and when the water is frozen it can diffuse only as a vapor, not as liquid. During the winter months the surfaces of the boards may dry to a moisture content of 16 to 17 percent. Slow diffusion causes the dry surface zone to be thin. The thin zone in tension may develop many fine surface checks because cold wood is less capable of assuming a deformation or set than warm wood.

The slight surface checking in lumber that was piled in October may be explained by the mild weather during the early part of the air-drying period. By the middle of November, when the average temperature is usually about 32° F., the lumber had dried enough so that the freezing of the free water in the interior of the boards was not so serious as it was in the case of the lumber

piled in January. The most severe surface checking would ordinarily be expected in lumber that was piled in May or July because this lumber had been exposed to relatively severe drying conditions during the early stages of drying. The average mean daily relative humidity in May was about 60 percent, that in July about 71 percent. This may account for the somewhat greater amount of surface checking in the lumber piled in May than in that piled in July.

End Splitting

Table 2 gives values that represent the average length of the longest end split at either end of the nine whole-board samples of each test package. The average length of the longest splits was smallest in the lumber piled in July and greatest in the lumber piled in May. The end splits were shorter in lumber that was air-dried in the shed than they were in lumber dried in the yard. Roofing the yard piles and using narrow, dry stickers reduced the length of the end splits somewhat. Although differences do exist between the lengths of the end splits in the various categories, the end splits were all short so that presumably the differences are of little practical significance.

Degrade Caused by Air-Drying Defects Other Than Stain

Table 3 presents losses in value during air drying, in dollars per 1,000 board-feet and in percentage of green value. Although losses in dollars per 1,000 board-feet are of more current interest, losses in percentage of green value are more useful for comparing the losses for other species and grades, or for comparing the results of past or future air-drying investigations.

The loss in dollars per 1,000 board-feet was greatest in the lumber piled during July, next in the January lumber, and least in the May lumber. The average loss for all of the test packages was $4.86 per 1,000 board-feet, or 5.8 percent of the green value of the lumber. The average loss for all of the lumber piled in the drying shed was $3.07 less than for the lumber piled in the yard. The loss from checking, splitting, and warping for lumber piled with wide, green stickers was only $0.12 greater than the loss for lumber piled with narrow, dry stickers. This indicates that the type of sticker had little effect on losses. The average loss in roofed yard piles was $1.54 per 1,000 board-feet less than the average loss for roofless piles.

Sticker Stain

Table 4 gives the number of sticker-stain marks that occurred on the boards of the four test packages. The sticker stain was largely a chemical stain, but in a few instances the chemical stain was accompanied by blue stain. It also gives the number of stain points, calculated by counting No. 1 stain as 1 point, No. 2 stain as 2 points, and No. 3 stain as 3 points. The stain points were adjusted to correspond to a test package of 150 boards.

The May test packages had the most stain points, and the October packages had the least. The large number of stain marks in the lumber piled for air drying during May was due to the extremely heavy staining in the lumber piled with wide, green stickers; the May lumber that was piled on narrow, dry stickers contained little stain. The differences between the number of stain points for the May, July, and January test packages were not great. In the eight test packages air dried in the shed, the average of stain points was 204; it was 282 for the 16 test packages air dried in the yard. The difference was due primarily to the complete absence of sticker-stain marks on the lumber piled with narrow, dry stickers in the shed. In lumber piled with wide, green stickers in the shed, there were 409 sticker-stain marks; there were 456 stain marks in lumber dried in the yard. The lumber piled with wide, green stickers stained about 6 times as much as the lumber piled with narrow, dry stickers; 440 stain points to 73. The yard piles that were roofed had fewer sticker-stain marks than those that were not roofed, but the principal difference was in the material piled on wide, green stickers.

The amount of sticker stain depended mainly on the type of sticker and the time of year. Other factors, such as shed or yard and roof or no roof, caused relatively slight differences. Lumber piled on narrow, dry stickers and air dried in the shed contained practically no stain.

The losses per 1,000 board-feet and in percentage of green value for each of the test packages are given in table 5. Stain caused the greatest loss in lumber piled during July and the least in lumber piled during October. The losses in value for the lumber piled in January were almost as great as those for lumber piled in July. Although the lumber piled in May contained more sticker-stain marks than the July or January lumber the sticker-stain marks on lumber piled in May caused less degrade. Exceptionally slight losses in packages built with narrow, dry stickers caused only moderate loss in the May test packages. Staining loss in lumber air dried in the shed was \$1.59 per 1,000 board-feet less than that in lumber air dried in the yard. Lumber piled with wide, green stickers had an average loss of \$5.72 per 1,000 board-feet greater than the loss for lumber piled with narrow, dry stickers. The roofs on the yard piles reduced the sticker-stain loss per 1,000 board-feet only \$0.27. This

indicated that water penetrating the tops of the piles and collecting underneath the stickers played a minor role only in sticker staining.

Degrade Caused by Checking, Splitting, Warping, and Sticker Staining

Table 6 gives the total losses, in value per 1,000 board-feet and in percentage of green value caused by all drying defects, for all of the test packages. The losses in value of the lumber piled in January and July are approximately equal and are greater than those of the lumber piled in May and October. The packages that started air drying during October suffered the least loss because there was almost no staining in the lumber piled during October. The lumber piled in May suffered moderate losses through sticker staining and other air-drying defects. The average loss in value for all of the lumber in the test packages was $9.42 per 1,000 board-feet, or 11.3 percent of the original green grade value. Lumber dried in the yard averaged $4.67 more loss per 1,000 board-feet than lumber air dried in the shed. For lumber piled with narrow, dry stickers, the average loss was $5.84 less per 1,000 board-feet than that for lumber piled with wide, green stickers. The roofed piles in the yard lost $1.80 less than the roofless piles.

Conclusions

One-inch sugar maple flooring stock (averaging a little better than No. 2 Common in grade) that was piled for air drying in Upper Michigan throughout the year dried to 20 percent moisture content in an average period of about 90 days. Lumber piled during the months of September through the following January dried to a moisture content of 20 percent by April. If a sawmill operates continuously, these drying data indicate that the capacity of the air-drying yard would have to equal 5 to 6 months' production.

Special narrow, dry stickers should be used in air-drying piles of sugar maple at this location. The use of green lumber stickers causes a sticker-stain loss of $5.84 per 1,000 board feet. Although the test packages of the study were at the top of the piles, this loss figure applies to all of the lumber in a pile.

The decreased degrade and savings brought about by air drying in the shed rather than in the yard indicate that a shed is a good investment. For roofed yard piles made with narrow, dry stickers, the shed saved $5.35 per 1,000 board-feet (or $6.01 per package, since the average package contained 1,123

board-feet). A pole-type shed with a floor area of 1,000 square feet costs about $0.75 per square foot of area, and will hold about six piles of lumber 4 feet wide and 16 feet long. With an average drying period of 90 days, the annual capacity of the shed will be 24 piles. Thus, at $6.01 per pile, the annual saving is $144.24. At this rate, the direct cost of the shed, $750, will be recovered in about 5-1/4 years. The figure $6.01 is severely discounted in the assumption that it applies only to the lumber in the top package; since the lumber of the test packages was of relatively low grade (average value $83.57 per 1,000 board-feet) the chances are good that 5-1/4 years is a conservative figure. With upper grade lumber, the cost of the shed (including interest and indirect charges) would probably be recovered in 4 to 5 years.

For lumber piled on narrow, dry stickers, a comparison of roofed yard piles with roofless piles indicates a saving of $1.70 per 1,000 board-feet, assignable to the roof. For a package containing 1,123 board-feet, the saving is $1.91. If this figure is limited to the lumber in the top package, as it was in the consideration of the effect of the shed, the figure can again be regarded as conservative. If a single pile roof is used four times a year it will save about $7.60 worth of lumber per year. With upper grade lumber the saving will be greater. If a pile roof could be built, maintained, handled, and amortized for $7.60 or less a year, an investment in pile roofs would be profitable.

Table 1.--Surface checking during air drying of the 16-foot whole-board samples of lumber packages piled in January, May, July, and October

Location	Sticker type	Roofed	Average total length of surface checks			
			January	May	July	October
			In.	In.	In.	In.
Shed	Narrow, dry	....	7	14	15	12
Do......	Wide, green	....	9	36	9	4
Yard	Narrow, dry	Yes	15	30	16	8
Do......	Wide, green	...do...	63	27	23	43
Do......	Narrow, dry	No	79	101	33	30
Do......	Wide, green	...do...	176	69	113	24
Average	....	....	58	46	35	20

Table 2.--End splitting during air drying of 16-foot whole-board samples of the lumber piled in January, May, July, and October

Location	Sticker type	Roofed	Length of the longest end split[1]			
			January	May	July	October
			In.	In.	In.	In.
Shed	Narrow, dry	....	2.9	1.9	1.8	2.9
Do......	Wide, green	....	3.9	3.1	2.0	2.8
Yard	Narrow, dry	Yes	1.8	3.4	3.0	1.9
Do......	Wide, green	...do...	4.3	2.9	2.6	2.9
Do......	Narrow, dry	No	2.7	4.1	2.4	2.7
Do......	Wide, green	...do...	1.9	3.8	3.7	3.0
Average	....	....	2.9	3.2	2.6	2.7

[1] These are averages found by adding the lengths of the longest end split in each whole-board sample, and dividing the total by 9, the number of whole-board samples.

Table 3.--Losses caused by checking, splitting, and warping during the air drying of lumber piled in January, May, July, and October, excluding stain

Location	Sticker type	Roofed	Loss in value during air drying									
			Dollars per 1,000 board-feet					Percent of green value[1]				
			January	May	July	October	Average	January	May	July	October	Average[2]
Shed	Narrow, dry	......	2.89	1.63	3.18	1.78	2.37	3.3	2.0	4.2	1.9	2.8
Do......	Wide, green	......	2.98	2.32	4.00	3.73	3.26	3.9	2.6	4.9	3.8	3.7
Yard	Narrow, dry	Yes	7.14	2.94	5.13	4.89	5.02	8.1	3.8	6.0	5.2	5.8
Do......	Wide, green	..do..	10.31	2.69	4.27	3.57	5.21	13.2	3.4	5.5	3.9	6.4
Do......	Narrow, dry	No	3.75	6.97	8.75	8.59	7.02	4.6	9.3	12.0	9.7	8.7
Do......	Wide, green	..do..	6.90	4.26	9.83	4.22	6.30	9.5	4.7	11.1	4.5	7.8
Average	....	......	5.66	3.47	5.86	4.46	....	[2]7.0	[2]4.4	[2]7.3	[2]4.7	....
Grand average	....	......	......	......	......	......	4.86	......	......	......	......	5.8
Group averages												
Shed	....	......	......	......	......	......	2.82	......	......	......	......	......
Yard	....	......	......	......	......	......	5.89	......	......	......	......	......
....	Narrow, dry	......	......	......	......	......	4.80	......	......	......	......	......
....	Wide, green	......	......	......	......	......	4.92	......	......	......	......	......
....	....	Yes	......	......	......	......	5.12	......	......	......	......	......
....	....	No	......	......	......	......	6.66	......	......	......	......	......

[1]Since the value of the green lumber in the test packages varied, the relation between the percentages and the losses per 1,000 board-feet is not a constant.

[2]These figures are true means and are not averages of the figures in the respective columns.

Table 4.--Sticker stain in the boards of the January, May, July, and October test packages

Location	Sticker type	Roofed	Number of sticker-stain marks												Adjusted stain points[2]				
			No. 1 stain[1]				No. 2 stain[1]				No. 3 stain[1]								
			Jan.	May	July	Oct.[3]	Jan.	May	July	Oct.	Jan.	May	July	Oct.	Jan.	May	July	Oct.	Av.
Shed	Narrow, dry	......	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Do.	Wide, green	......	503	410	448	27	19	77	20	0	0	5	0	0	545	587	471	34	409
Yard	Narrow, dry	Yes	109	23	217	0	0	0	0	0	0	0	0	0	117	23	219	0	90
Do.	Wide, green	..do..	355	446	346	20	107	119	12	0	0	29	0	0	585	799	363	26	443
Do.	Narrow, dry	No	152	44	197	102	0	0	0	0	0	0	0	0	155	41	204	116	129
Do.	Wide, green	..do..	391	513	416	105	15	75	97	11	0	3	7	0	470	673	594	134	468
Av.	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	312	354	308	52	.....

[1] No. 1 stain light or perceptible; No. 2 stain light, medium or readily perceptible; No. 3 stain medium or conspicuous. Nos. 1 and 2 were chemical stains, while No. 3 was probably a combination of chemical and fungal stain.

[2] No. 1 stain counted as 1, No. 2 stain as 2, and No. 3 stain as 3. All values were adjusted to correspond to a package of 150 boards. For example: 150 boards, multiplied by 5 times 2 stickers, equals 1,500 sticker crossings. The bottom and top lumber courses have only one set of sticker crossings. The number of boards in a course averages about 6-1/2. Subtracting 5 x 13 from 1,500 gives 1,435 sticker crossings for a 150-board package. A package of 146 boards will have 1,395 crossings. $\frac{1,395}{1,435} = 0.972$, which is the correction factor in this instance.

[3] Some of the stains in the October boards were light-colored streaks bounded by darker areas.

Table 5.--Loss in value caused by sticker stain during air drying of lumber piled in January, May, July, and October

Location	Sticker type	Roofed	Loss in value during air drying									
			Dollars per 1,000 board-feet					Percent of green value[1]				
			January	May	July	October	Average	January	May	July	October	Average[2]
Shed	Narrow, dry	......	0	0	0	0	0	0	0	0	0	0
Do......	Wide, green	......	9.96	8.07	9.96	0	7.00	13.0	9.0	12.2	0	8.5
Yard	Narrow, dry	Yes	4.69	0	6.08	0	2.69	5.3	0	7.1	0	3.0
Do......	Wide, green	..do..	10.52	10.80	7.57	0	7.22	13.5	13.7	9.6	0	9.0
Do......	Narrow, dry	No	4.93	.79	3.91	0	2.41	6.1	1.1	5.0	0	3.0
Do......	Wide, green	..do..	7.67	8.21	12.49	3.81	8.04	10.3	9.7	12.0	4.1	9.9
Average	....	......	6.30	4.65	6.67	.64	....	[2]7.8	[2]5.6	[2]8.4	[2].7	....
Grand average	....	......	......	......	......	......	4.56	......	......	......	......	5.5
Group averages												
Shed	....	......	......	......	......	......	3.50	......	......	......	......	......
Yard	....	......	......	......	......	......	5.09	......	......	......	......	......
....	Narrow, dry	......	......	......	......	......	1.70	......	......	......	......	......
....	Wide, green	......	......	......	......	......	7.42	......	......	......	......	......
....	....	Yes	......	......	......	......	4.96	......	......	......	......	......
....	....	No	......	......	......	......	5.23	......	......	......	......	......

[1]Since the value of the green lumber in the test packages varied, the relation between the percentages and the losses per 1,000 board-feet is not a constant.

[2]These figures are true means and are not averages of the figures in the respective columns.

Table 6.--Loss in value caused by drying defects and sticker stain during the drying of piles erected in January, May, July, and October

Location	Sticker type	Roofed	Loss in value during air drying									
			Dollars per 1,000 board-feet[1]					Percent of green value[2]				
			January	May	July	October	Average	January	May	July	October	Average[3]
Shed	Narrow, dry	......	2.89	1.63	3.18	1.78	2.37	3.3	2.0	4.2	1.9	2.9
Do......	Wide, green	......	12.94	10.39	13.96	3.73	10.26	16.9	11.6	17.1	3.8	14.3
Yard	Narrow, dry	Yes	11.83	2.94	11.21	4.89	7.72	13.4	3.8	13.1	5.2	6.7
Do......	Wide, green	..do..	20.83	13.49	11.84	3.57	12.43	26.7	17.1	15.1	3.9	15.4
Do......	Narrow, dry	No	8.68	7.76	12.66	8.59	9.42	10.7	10.4	17.0	9.7	11.7
Do......	Wide, green	..do..	14.57	12.47	22.32	8.03	14.35	19.8	14.4	23.1	8.6	17.8
Average	....	......	11.96	8.11	12.53	5.10	....	[3]14.8	[3]9.9	[3]15.7	[3]5.4	....
Grand average	....	......	......	......	......	......	9.42	......	......	......	......	[3]11.3
Group averages												
Shed	....	......	......	......	......	......	6.31	......	......	......	......	......
Yard	....	......	......	......	......	......	10.98	......	......	......	......	......
....	Narrow, dry	......	......	......	......	......	6.50	......	......	......	......	......
....	Wide, green	......	......	......	......	......	12.34	......	......	......	......	......
....	....	Yes	......	......	......	......	10.08	......	......	......	......	......
....	....	No	......	......	......	......	11.88	......	......	......	......	......

[1]The values for loss per 1,000 board-feet in this table are the sums of those in tables 3 and 5.

[2]Since the green value of the lumber in the test packages varied, the relation between the percentages and the losses per 1,000 board-feet is not a constant.

[3]These figures are true means not averages of the figures in the respective columns.

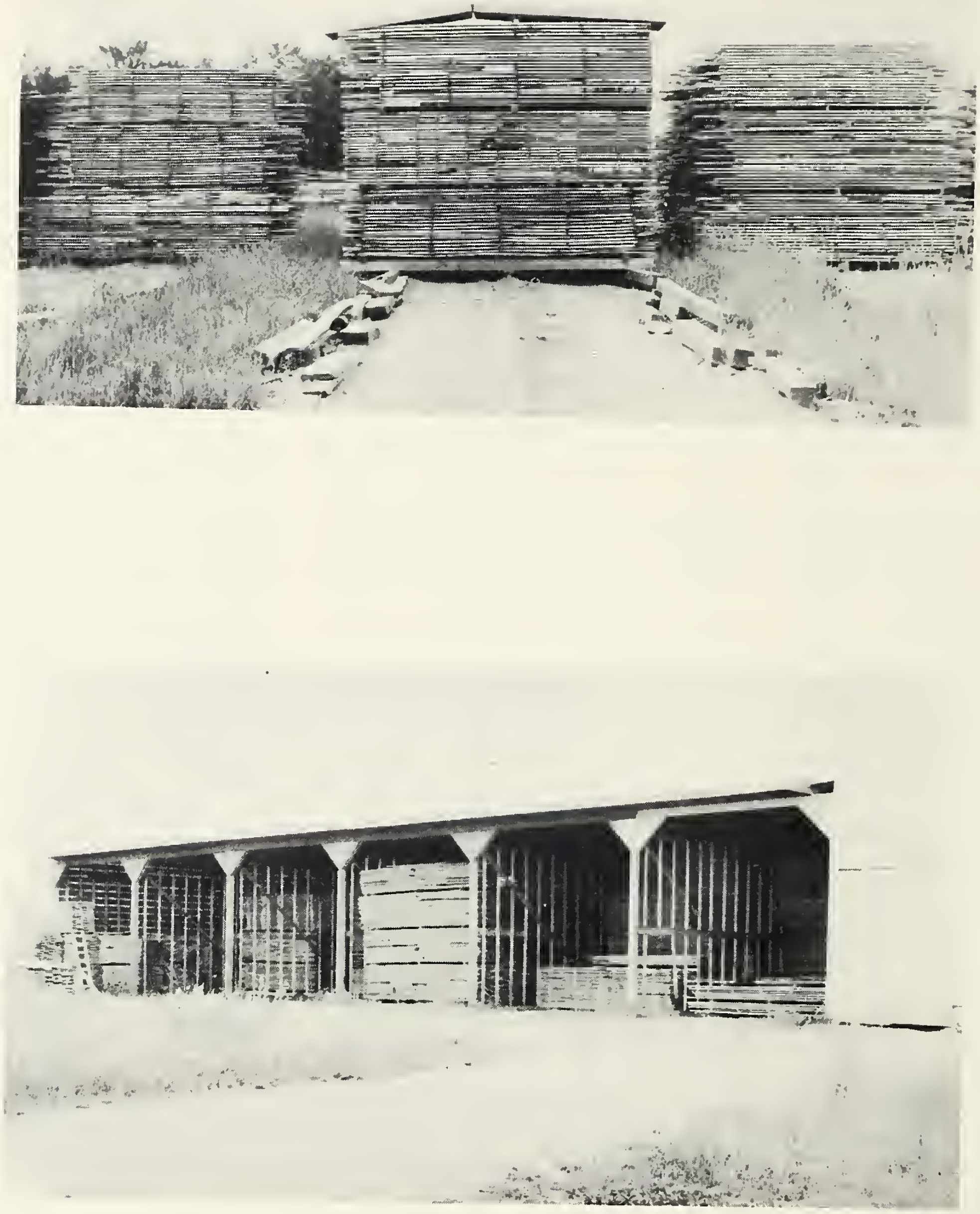

Figure 1. --Upper, test package placed on top of two other packages to form a yard pile, with a 2-panel roof. Lower, shed, open on two sides, in which air drying experiments were conducted.

Z M 100 230

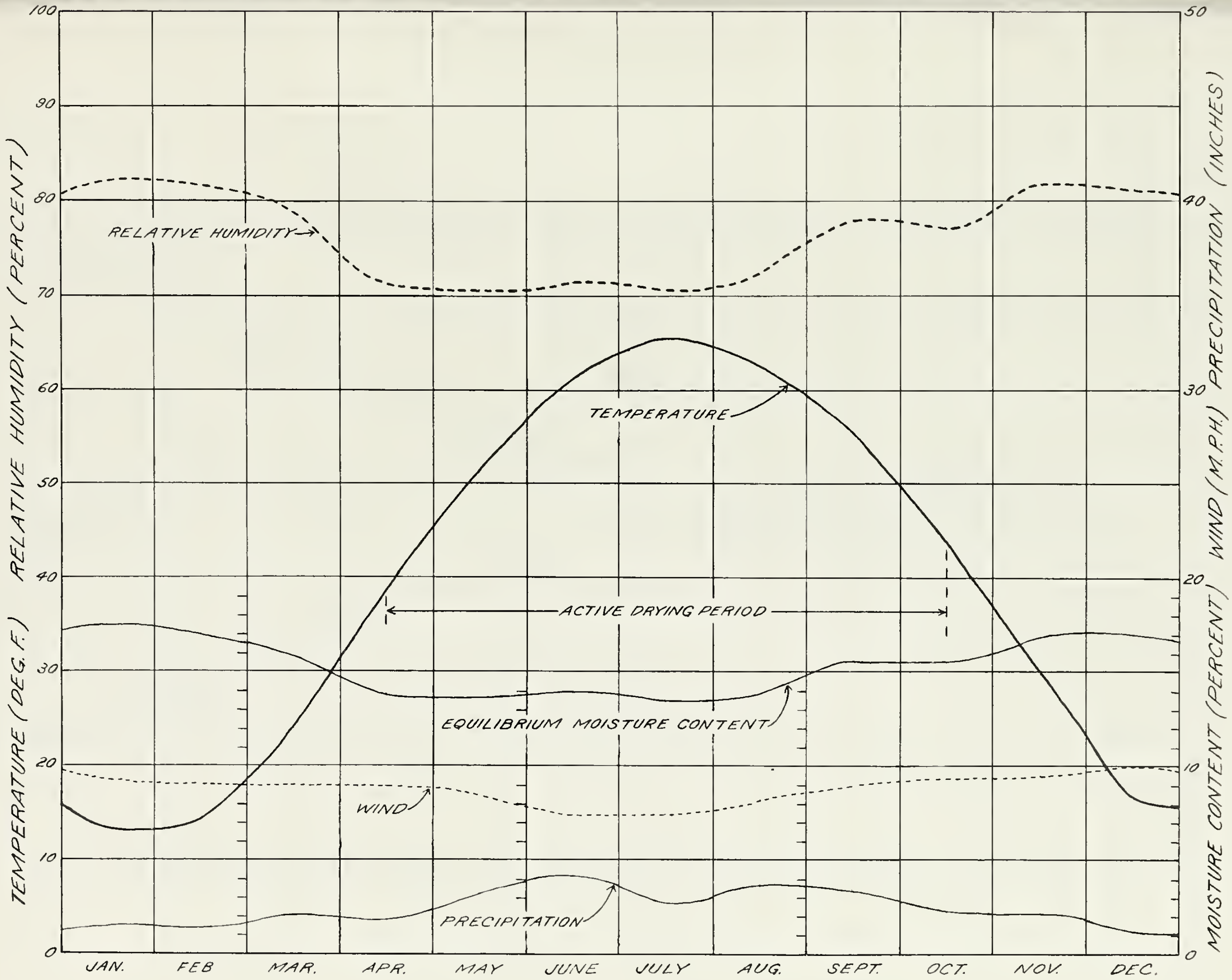

Figure 2. --Climatological conditions and corresponding wood equilibrium moisture content at the site of the experiment (temperature and relative humidity plotted on the basis of mean monthly values).

Z M 110 526

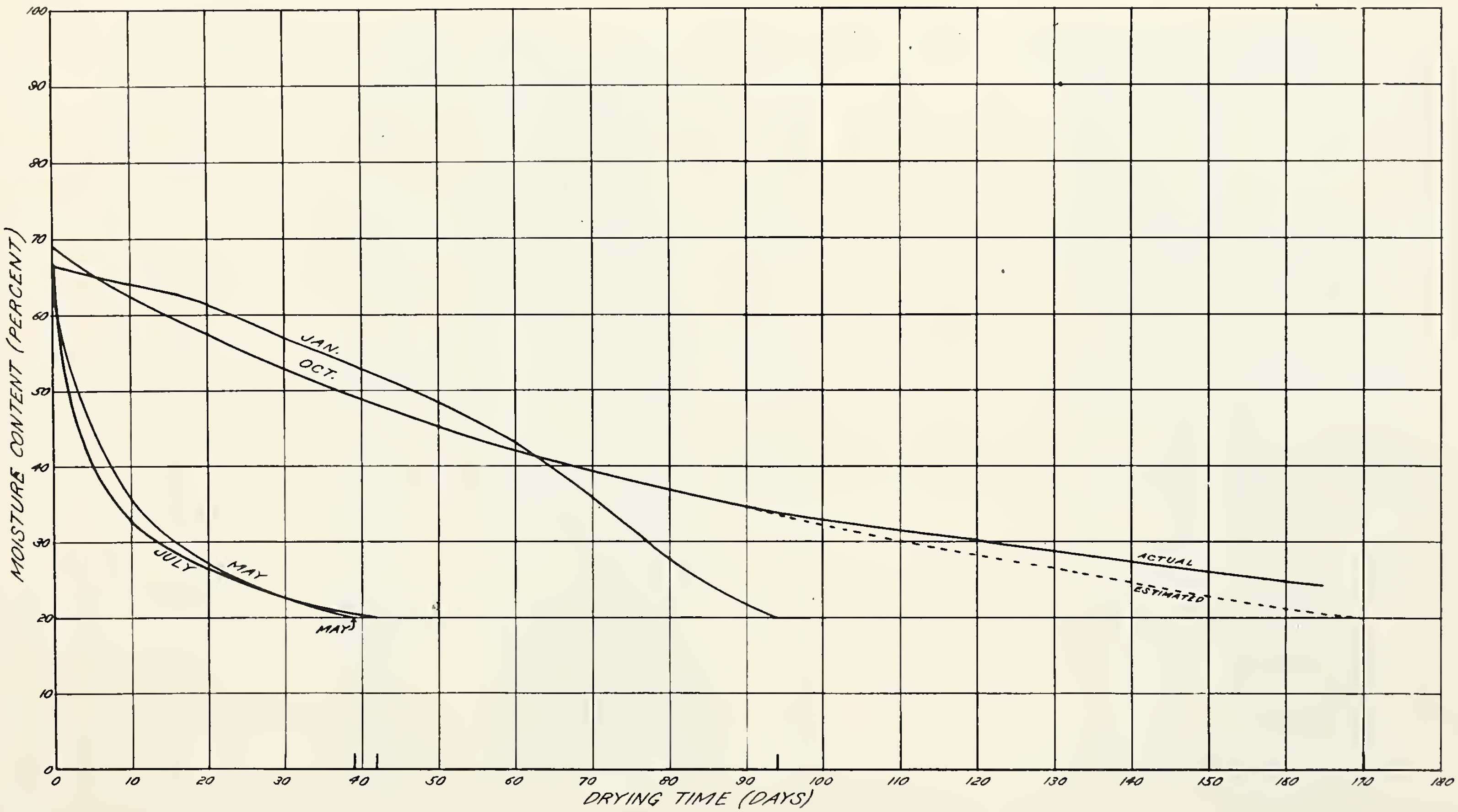

Figure 3. --Drying curves for the lumber in the four sets of experimental packages, showing the days required to reach a moisture content of 20 percent.

Z M 109 195

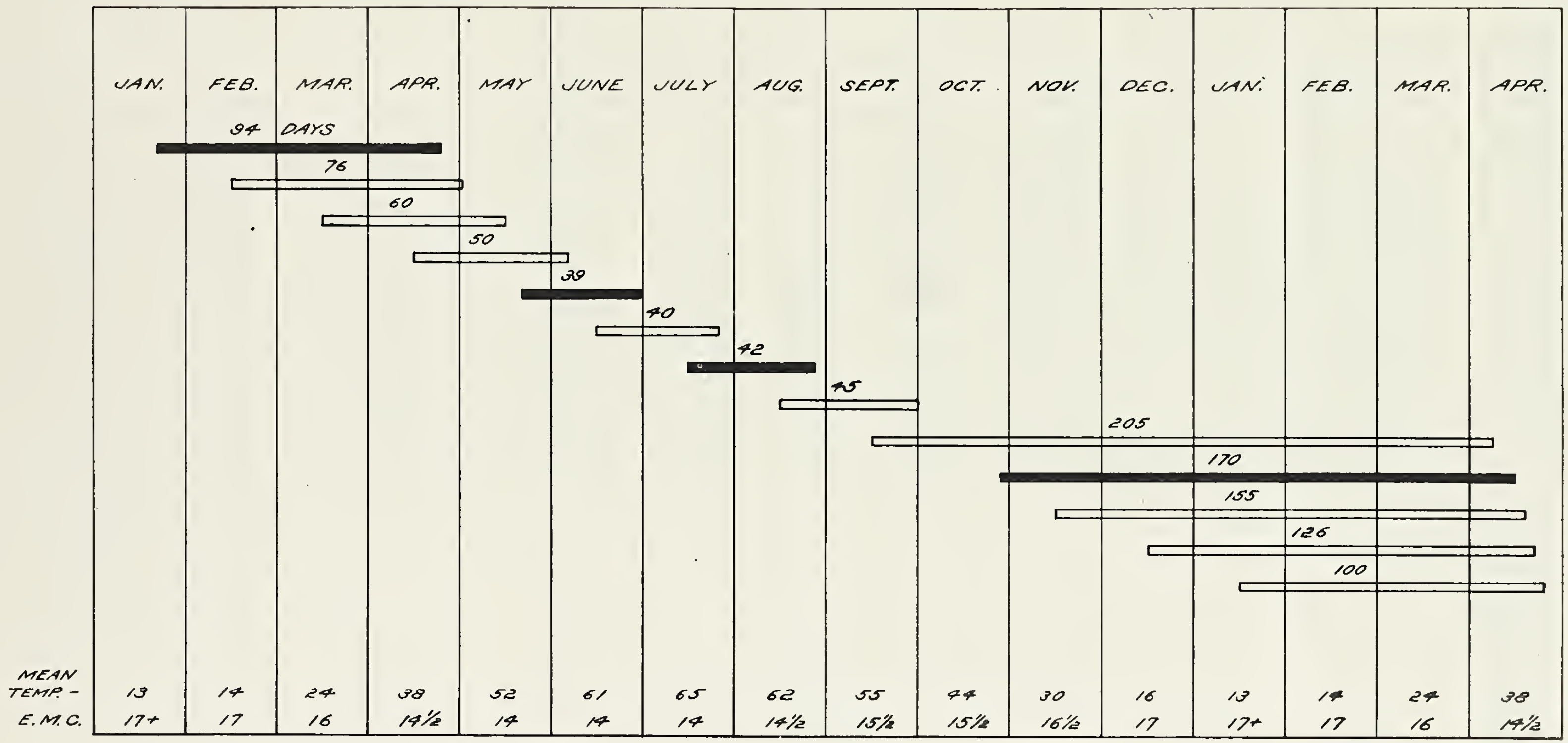

Figure 4. --Days required to air-dry 4/4 sugar maple flooring stock to a moisture content of 20 percent in Upper Michigan (solid bars represent test packages; outlined bars are estimates).

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